PATENT

Attorney Docket No. RS151

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:

WESLING et al.

Serial No. 10/707,079

Filed: November 19, 2003

For: LOCKOUT MECHANISM FOR A SUSPENSION SYSTEM

Group Art Unit 3611

Examiner: Daniel S. Yeagley

I hereby certify that this correspondence is being transmitted to the Patent and Trademark Office via EFS-Web, on

August 3, 2006
Date

Lisa Serdynski
Typed Name

Lisa Serdynski
Signature

DECLARATION

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Kevin Wesling declares that:

1. I am one of the coinventors of claims 1-40 of the above-identified patent application.

2. Prior to June 30, 2003, I filled out an invention disclosure form (Exhibit) describing a suspension system having a lockout mechanism and an adjustable blow-off mechanisms as described and claimed in the invention and delivered it to Milan Milosevic, the in-house patent attorney for SRAM Corporation, the assignee of the present invention. I also attached drawings of one embodiment of the present invention to the invention disclosure form.

Serial No. 10/707,079

3. Prior to June 30, 2003, I designed a Pro/E computer model of the claimed invention and then a prototype was constructed in-house based upon the drawings, as evidenced by page 2 of the invention disclosure form, Exhibit.

4. As seen and/or described in Exhibit, the suspension system includes a lockout mechanism including a valve mechanism and a valve actuating assembly, a valve mechanism housing and a resilient member disposed between the valve mechanism and the valve mechanism housing. The valve mechanism is slidably mounted along the valve mechanism housing and separates a first fluid chamber from a second fluid chamber to control the fluid flow therebetween. The valve actuating assembly operably switching the valve mechanism between an open position and a closed position. The resilient member is configured to be deformable by the valve mechanism as the valve mechanism is slidably displaced by an increasing pressure in the first fluid chamber. The increasing pressure biases the valve mechanism toward the closed position. The sliding valve mechanism is configured to collide against the valve actuating assembly when a blow-off pressure is reached in the first fluid chamber switching the valve mechanism from the closed position to the open position.

5. Each of the dates deleted from Exhibit is prior to June 30, 2003.

6. I further declare that all statements made herein of my own knowledge are true and that all statements made upon information an belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application of any patent issued thereon.

Kevin Wesling

Dated: 8/3/2006

INVENTION DISCLOSURE

I. TITLE OF INVENTION

Hydraulic shock lockout.

II. INVENTOR(S)

Full Name Kevin Wesling
Citizenship USA
Address ____________________

Full Name John Cheever
Citizenship USA
Address ____________________

Full Name Christopher Shipman
Citizenship USA
Address ____________________

Full Name Brian Jordan
Citizenship USA
Address ____________________

III. BRIEF DESCRIPTION OF THE INVENTION
(Attach additional pages and drawings, as necessary)

The invention is a shock absorber that can be made to be substantially rigid at the user's discretion. It is a low cost design that has fewer parts than the prior art. It also provides a means to relieve pressure in the system by "blowing off" and becoming active at a predetermined threshold force. The design is inherently low cost but also allows the blow off threshold to be easily adjusted by the rider. It also provides for a small amount of compliance in the fork when the shock is locked out. By this the fork is able to actuate, but at a significantly higher rate than when the fork is not locked out. In this way, the fork is "substantially rigid" so as be efficient during pedaling and also allows some shock absorption for the rider.

IV. CONCEPTION OF INVENTION

a. When did the invention first occur to you (give date)?

Initial concept on train ride. Chicago to Lombard. Further development work with Brian Jordan and Christopher Shipman in war room on .

b. When and to whom, other than co-inventors, did you first communicate the invention (give date)?

Phone conversation with Mark Norris. .

c. When and where was the first sketch, drawing, or photograph, if any, made of the invention? Identify and attach copy.

Between and . KW sketch pad. Transferred to lab notebook .

d. When was the invention first described in writing? Give date and identify notebook, report or other source, attach copy.

Same as c. above.

e. Identify pertinent descriptions, reports, summaries, drawings, photographs, etc., subsequent to d. above.

The design went straight from Sketch to PROE model to prototype. Three stages were made.

Lockout w/o blowoff.
Designed and prototyped by KW . Shown to RS .

Lockout with blowoff.
Designed and prototyped by KW . Shown to RS

Lockout with adjustable blowoff.
Designed and prototyped by KW . Shown to RS .

V. CONSTRUCTION OF DEVICE / TESTING

a. Date construction started ______

Date completed ______

Made by ______

b. Date of first test / experiment ______

Made by ______

Results ______________________________

Witnesses ______________________________

c. Date of first successful test / experiment ______________________________

Made by ______________________________

Results ______________________________

Witnesses ______________________________

VI. SALE / USE / PUBLICATION

a. Place and date of first sale or offer for sale, if any (give details)

Not applicable.

b. Place and date of first public use, if any (give details)

Not applicable.

c. Place and date of publication or communication outside the company, if any. If so, are nondisclosure agreements in place governing all said publications and communications (give details)?

None.

VII. STATE OF THE ART

a. Closest prior art known to inventor (Patents, Publications, Products, etc.) Attach copies.

SRAM/Rockshox "PURE" lockout system.
Manitou "NoBob" lockout system. Pat US 6,120,049.

b. Closest SRAM prior art known to inventor(s)

SRAM/Rockshox "PURE" lockout system.

c. Disadvantages of the prior art

High cost due to higher quantity of parts and more expensive parts required.
No means to easily adjust the blowoff threshold without disassembling the fork.
Operation in "locked out" state is too rigid, providing an harsh and uncomfortable ride.

d. Objects and advantages of the invention

1. Low cost solution to shock lockout. Fewer and simpler parts.
2. Low cost solution to hydraulic "blow-off". Fewer and simpler parts.
3. Provides a simple means to adjust threshold of blowoff force. Tunable per rider specs.
4. Provides "high rate" locked out mode which is efficient for pedaling but compliant enough to absorb small variations in the terrain.

VIII. DESCRIPTION OF THE INVENTION

Attach a detailed description of the invention, including:

i) drawings, charts, photographs, etc.,

ii) description of alternative embodiments (including best mode),

iii) description of a cycle of operation,

iv) widest reasonable ranges of operation, proportions of materials and conditions used and disadvantages of working outside said ranges, and

v) contributions of each named inventor.

IX. INVENTOR SIGNATURES

Signature:	Name:	Date:
Kevin Wesling	Kevin Wesling	
Chris Shipman	CHRIS SHIPMAN	
John Cheever	John Cheever	
Brian T. Jordan	Brian T. Jordan	

Disclosed to and understood by the undersigned witnesses:

Signature:	Name:	Date:

Exhibit 4 of 20

BACKGROUND

The function of a shock absorber on a moving vehicle (bike, motorcycle, car etc.) is to absorb the irregularities on the riding surface such that the rider of the vehicle feels a smoother ride than if there was no shock absorber. The suspension should be designed to accommodate large variances in riding surface, as well as large variances in the size and riding style of the rider. It is therefore advantageous to produce a shock absorber that is able to function on very rough terrain as well as smooth terrain and is able to accommodate heavy riders as well as lighter riders.

The bicycle in particular has another reason to control the action of the shock. Motorized vehicles have forces from the ground working upward on the frame of the vehicle. A bicycle has these forces as well as the forces from the pedaling of the bicycle acting downward upon the frame of the vehicle. The rider can therefore actuate the suspension by pedaling the bicycle. The result is that the bike bobs up and down as the rider pedals. This up and down motion is wasting energy that is supposed to going toward propelling the bike forward. On rough terrain, this is an acceptable byproduct of having a fully active suspension capable of absorbing large bumps in the road. On smooth terrain, the bobbing motion is an unacceptable waste of energy.

The solution to this problem is to have a shock that can be turned on and off. If the fork is on, it is "active" and actuating in response to bumps in the road. If it is off, it is "locked out". It is functioning as a rigid fork and not actuating at all in response to bumps in the road. If the sock is locked out, it is advantageous to have another condition whereby when the forces on the shock reach some threshold level, the lock out mechanism "blows off". This is a safety feature that limits the forces on the shock and the rider in locked out mode.

A typical example of usage is as follows. A bike rider is riding his fork on a rough off-road path. The rider wants the shock to be fully active at this point. The trail ends and the rider is now on a paved road. The rider now wants the shock to be locked out so no energy is wasted in bobbing. The shock is now a rigid member so any forces acting on the shock are imparted directly to the rider. As the rider approaches another off road trail, the rider forgets to "un-lock" the fork and rides off a large drop-off. The rider wants the lockout to release and blow-off, allowing the fork to actuate for his safety and the long-term operation of the suspension.

It is also advantageous to be able to adjust the force at which the fork blows off and becomes active. It the rider is very large, then the pedaling forces will be higher than if the rider were lighter weight. If the lock out blow off force is set high to prevent a large rider from actuating the fork while pedaling, the same setting may be set too high for a lighter rider to reach the blow off force under normal riding conditions.

The following paragraphs describe use a front suspension fork to describe the prior art and the invention. The invention is not limited to front suspension forks. The invention can be easily applied to rear shocks as well.

PRIOR ART

A typical suspension fork is shown in Figure 1. It consists of an upper assembly, including the steerer tube, crown, and stanchion tubes and a lower assembly consisting mainly of the lower tubes or the housing. The fork is attached to the bike frame at the steerer tube and to the bicycle wheel at the dropouts. As forces are applied to the wheel, the lower tubes slide relative to the upper tubes and the height of the fork decreases. The forks usually have a spring element to resists this motion and to urge the lower and upper tubes apart. This spring can be a metal coil spring or air spring and is usually located in one or more of the stanchion tubes.

Suspension forks often are hydraulically dampened. This damping is the result of using a piston to force oil through a restrictive orifice to slow down the speed of the fork and dissipate energy in the process. There are many different ways to dampen a suspension fork but it suffices to say that the smaller the orifice, the more the oil is restricted to flow and the less the fork will actuate for a given compression hit. Thus, to completely restrict the flow of oil is to shut down the operation of the fork and make it "locked-out". This is a common way to lock out a suspension fork Examples of this in the prior art include the Rockshox "Pure" system and the Manitou "No Bob" system shown in Figures 2 and 3.

The two examples look different but behave very much the same with respect to lockout. Both use oil pressure and flow to effect a lockout and blow off. The oil pressure is generated by the action of a compression piston that is attached to the lower assembly. As the lower tubes are driven upward, oil is pushed upward into the stanchion tube toward and through the lockout assembly. The lockout assemblies are attached to the top cap. On each of the top caps, is a knob that allows the user to "lock-out" the fork or unlock it to make it "active". In the lockout assemblies are three valves. These are,

1. the on/off lockout valve,
2. the blow off valve, and
3. the oil return valve.

What these valves do depends on whether the fork is locked out or not. If the fork is not locked out, then the on/off lockout valve is open. As the compression piston rises, oil freely flows through the on/off lockout valve, past the lockout piston and back again as the compression piston lowers. The other two valves are not necessary for operation when the fork is active.

When the on/off lockout valve is closed, the fork is locked out. No oil is allowed to flow through this valve. Assuming the oil in the shock is incompressible under these conditions and assuming there is no air between the compression piston and lockout piston, the fork is not able to compress. At this point, the suspension fork acts like a rigid fork. If the fork sees a high enough load the blow off valve will open. The blow off valve is held closed against the lockout piston by a heavily preloaded spring. The oil pressure produced by the compression piston in the compression chamber can get high enough to crack open the blow off valve. In this way, oil pressures are limited to this blow off pressure and this protects the internals of the fork as well as the forces on the rider. Once the blow off valve has "blown off" the oil must return to the other side of the lockout piston. A lightly sprung return valve is needed to let oil return to the

compression chamber. The blow off and return valves are both one way valves that permit flow in one direction but no flow in the opposite direction.

The negatives of this type of lockout are as follows.

1. High cost. The three valves require three pairs of valve quality surfaces. The valves need to be sprung or actuated requiring more parts.
2. Non –adjustable. The blow off force is determined by the pre-load on the blow off spring. This is not easily adjustable without taking the fork apart. Different weight riders would benefit from different blow off pressures.
3. Excessive rigidity. When the fork is locked out, it is very rigid offering no compliance over any bumps in the road. A rigid fork will bounce off small rocks making climbing difficult. It is better to have a small amount of travel with a very high spring rate to minimize bobbing but still provide some movement over small bumps.

The object of the invention as described below, is to provide a lockout system that overcomes these problems.

DESCRIPTION OF THE INVENTION

The parts to describe the invention are shown in the assembly drawing of Figure 4. These include:

Knob	Top cap
Set Screw	Cam
Poker Return Spring	Poker
Spring Tube	Stanchion Tube
Valve	Valve Body
Valve Spring	Compression Piston
Lower Tube	

The connectivity of these parts is now described. The stanchion tube slides inside the lower tube. When the fork is fully compressed, the stanchion tube bottoms out in the lower tube. When the fork is fully extended. The stanchion tube is restricted from pulling out of the lower tube by the compression piston. This compression piston is fixed to the lower end of the lower tube so that they cannot move relative to each other.

The stanchion tube has a quantity of oil within it. The oil level should be determined to be the amount of oil from the lower seal in the stanchion tube to a level just above that of the valve body. In some cases where the compression piston is acting a damper, the oil will flow through the compression piston and fill up the lower volumes of the stanchion tube. In other cases, the compression piston will seal against the stanchion tube and oil will not be allowed to flow past. In either case, the upward motion of the compression piston, during the compression of the fork, raises the level of the oil in the stanchion tube. The stanchion, lower tube, compression piston relationship is common to many suspension forks.

The invention consists of the assembly of parts shown in the upper section of the stanchion tube in Figure 4. Figure 5 shows the connectivity of the parts of the invention. The top cap screws into the stanchion tube. Once inserted it is rigidly fixed to the stanchion tube and seals prevent oil from escaping from inside the stanchion tube. The cam rides in a counter bore on the underside of the top cap. It is allowed to rotate along its axis relative to the top cap. It cannot move axially being constrained by the knob screw and the inner surface of the top cap. The cam is rotationally fixed to the knob by hexagonal features in the knob and the cam. The user turns the knob to change the fork from one state to another.

As the user rotates the cam through the knob, the poker is driven up and down as the cam contacts the pin on the poker. The poker is free to move up and down, but is held rotationally fixed by the slot in the top cap. Also, the cam can only be rotated a fixed amount before it drives the pin into a vertical stop at each end of the cam surface. The poker-return spring biases the poker upward into the cam surface.

Within the cam is an additional set screw. This set screw can do nothing when it is in its raised position or it can limit the return of the poker when it is screwed down. In this way, as the cam is rotated, the poker is rising in response the poker return spring, it will follow the cam until the poker hits the set screw. The set screw will limit the return of the poker regardless of how much more the cam is rotated.

The spring tube is pressed onto the underside of the top cap. A counter bore in the spring tube limits the engagement between the top cap and the spring tube. There is room between the top cap and the spring tube to place an o-ring seal to seal the top cap and the stanchion tube. Inside the spring tube is a thin section with a hole slightly larger than the poker. This section acts as a guide for the poker to keep its motion straight up and down and to support the lower surface of the poker return spring.

The valve body is pressed into the underside of the spring tube. The valve body has an o-ring seal around its circumference. At its center it supports the valve and the valve spring. The valve is sprung closed by the valve spring or sprung such that the inside face of the valve rests on the lower face of the valve body. In its closed state, pressurized oil from the compression piston is restricted from flowing through the valve. In its open state, the holes in the valve body permit free flow of oil through the valve body when the fork is compressed.

It is the interaction of the poker with the valve stem that forces the valve down and causes the valve to open and close. The operation of this valve depends on the conditions of the ride and the set up of the rider. These are described next.

DESCRIPTION OF OPERATION

In one state valve is open as shown in figure 6. The rider has turned the knob to turn the cam, which has driven the poker downward on to the valve stem, opening the valve. When the valve is open, the oil driven upward by the compression piston is free to rise and flow through the valve. It is also free to return as the fork extends. The rider feels only the spring rate from the primary spring member in the other leg.

Figure 7 shows the assembly in "locked out" mode. The cam has been turned, allowing the poker return spring to push the poker up and away from the valve stem. The valve spring pushes the valve upward against the valve body and no oil is permitted to flow through the valve body. If the oil cannot flow then the compression piston cannot move and the shock is essentially locked out.

This invention now provides for two options in "locked out" mode. The first is to assume that the spring tube is a rigid member. In this case, the oil pressure against the valve and valve body has no effect except to shut down the motion of the fork. The rider would thus feel a completely rigid fork with no compliance at all. This case is the lowest cost solution, providing a means to turn the suspension on and off with no means to "blow off" at high compression forces. A second valve can be added to provide a spring loaded blow much like in the prior art.

The second case is to make the spring tube out of a material and in the form of a stiff spring. Thus when the valve is closed, the oil pressure against the valve and valve body will compress the spring tube. The valve and valve body will rise upward as the spring tube collapses. The rider will now see motion in the fork, but at a combined rate of the primary compression spring and the spring tube. This combined spring rate will be stiff enough to minimize bobbing, while compliant enough to absorb some small bumps in the road.

The valve and valve body will rise upward under higher and higher forces until the valve stem makes contact with the poker. The valve is now restricted from moving upward by the poker. The oil pressure must now rise enough to push the valve body upward and away from the valve. When the valve body and the valve are separated, the valve is cracked open and oil is allowed to flow though the valve body. This cracking open of the valve at high pressures is called "blow off". This limits the maximum force on the spring tube and other parts of the assembly. During the return stroke, the compression piston changes direction and any oil which has passed through the valve body during blow off easily returns through the valve body by creating a vacuum drawing the valve down against the light valve spring.

It is important to note that the pressure at which the valve blows off is determined by the separation distance of the valve stem and the poker, and the spring rate of the spring tube. For example, if the primary spring rate was 50 pounds/in and the spring tube was 100 pounds/in and the separation of the poker and the valve stem was 0.5 inches then the spring rate of the fork in locked out mode would be:

$$50 \text{ pounds/in} + 100 \text{ pounds/in} = 150 \text{ pounds/in}.$$

And the force at which the locked out fork would blow off would be:

$$(0.5 \text{ in})(50 \text{ pounds/in} + 100 \text{ pounds/in}) = 75 \text{ pounds}.$$

Once again, when the fork is set to "locked out" mode, it is the separation of the poker and the valve stem that therefore determine the force at which the lockout will blow off. The poker is always force upward by the poker return spring. The cam surface determines how high the poker will rise and how far the poker will be separated from the valve stem. Figure 9 shows a case

where the poker is allowed to move upward the maximum distance as allowed by the cam. The cam can be a multiple position cam, designed to stop the poker at various distances from the valve. This results in different "blow off" forces for each position.

It is shown in figure 10, that the poker can be restricted from upward movement by an additional element. A set-screw, located in the cam body can restrict the upward movement of the poker. In this way, the user can twist the knob to turn the lock out on or off, and separately adjust the blow off force with a different knob. When the lock out if off, the poker is held down by the cam, but when the cam is turned, the poker pin comes off the cam surface and rides on the set screw.

CONTIBUTIONS OF EACH INVENTOR

Kevin Wesling – Basic concept of the one valve replacing three. Adjustable blow off through poker/valve stem separation. High rate lockout instead of rigid lockout.

Christopher Shipman – Blow off conception and development.

John Cheever – Best concept for adjustable blow off with set screw in cam body

Brian Jordan – Development of the spring tube.

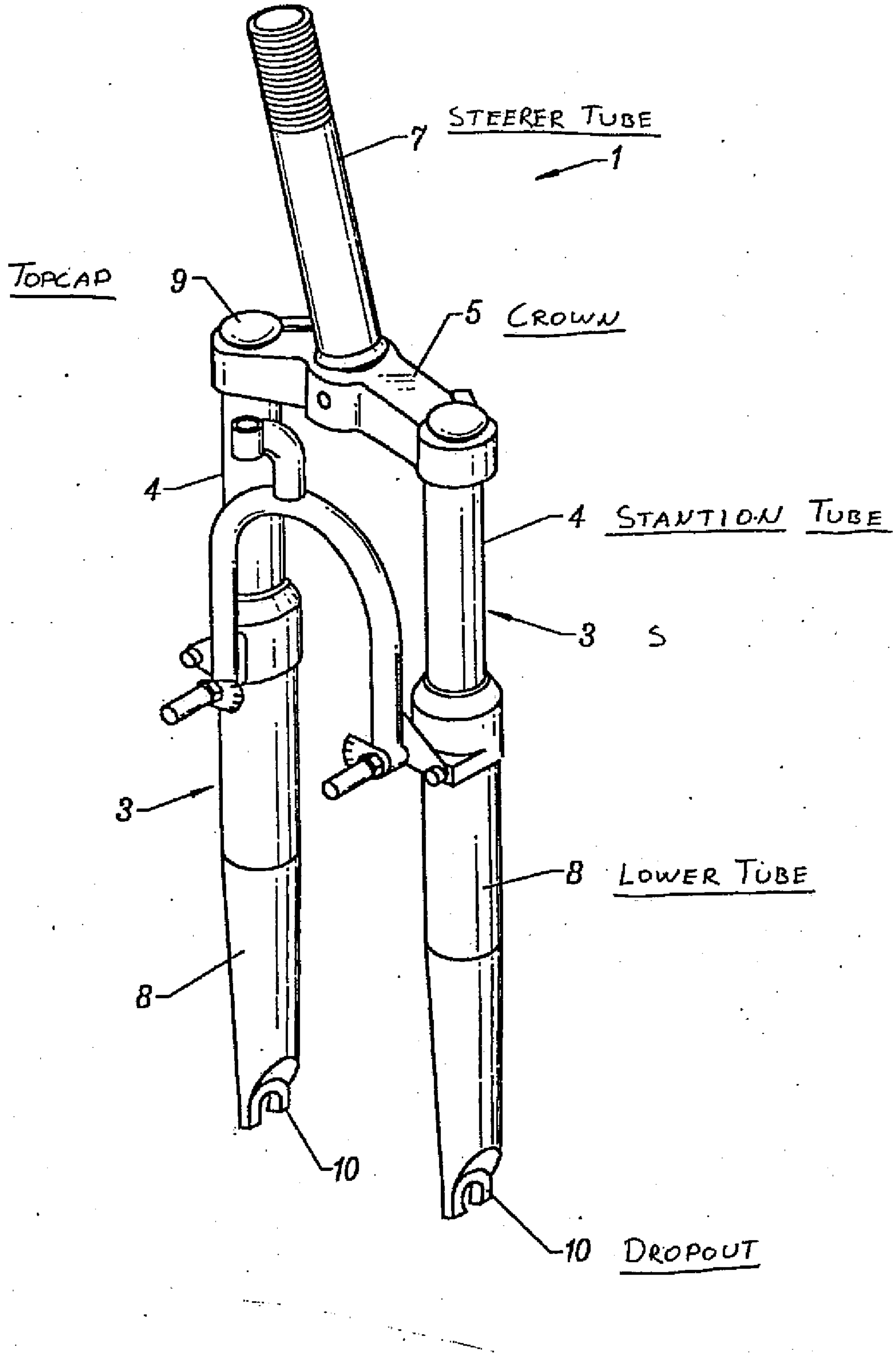

Figure 1

Exhibit 11 of 20

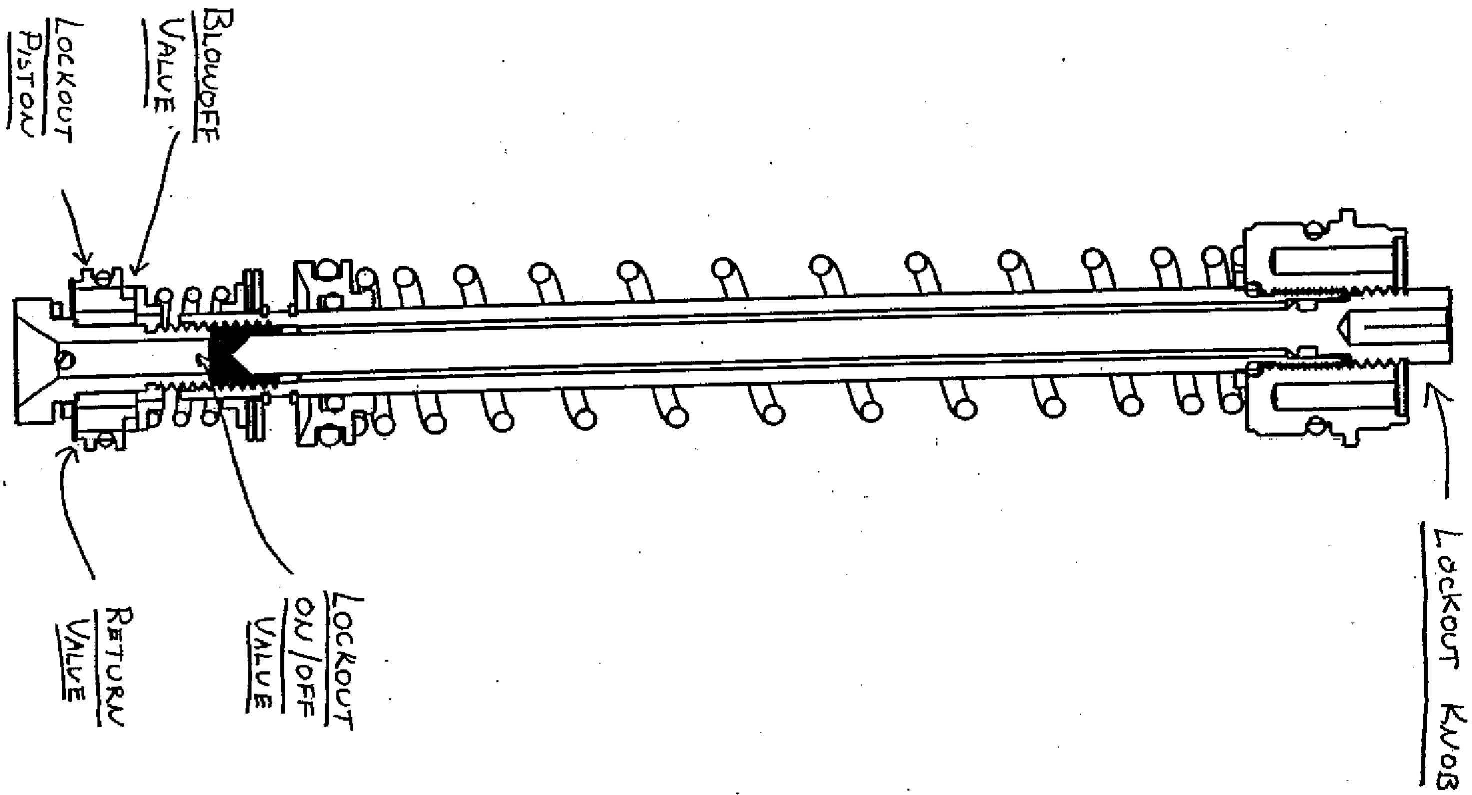
BLOWOFF VALVE
LOCKOUT PISTON
RETURN VALVE
LOCKOUT ON/OFF VALVE
LOCKOUT KNOB

Figure 2

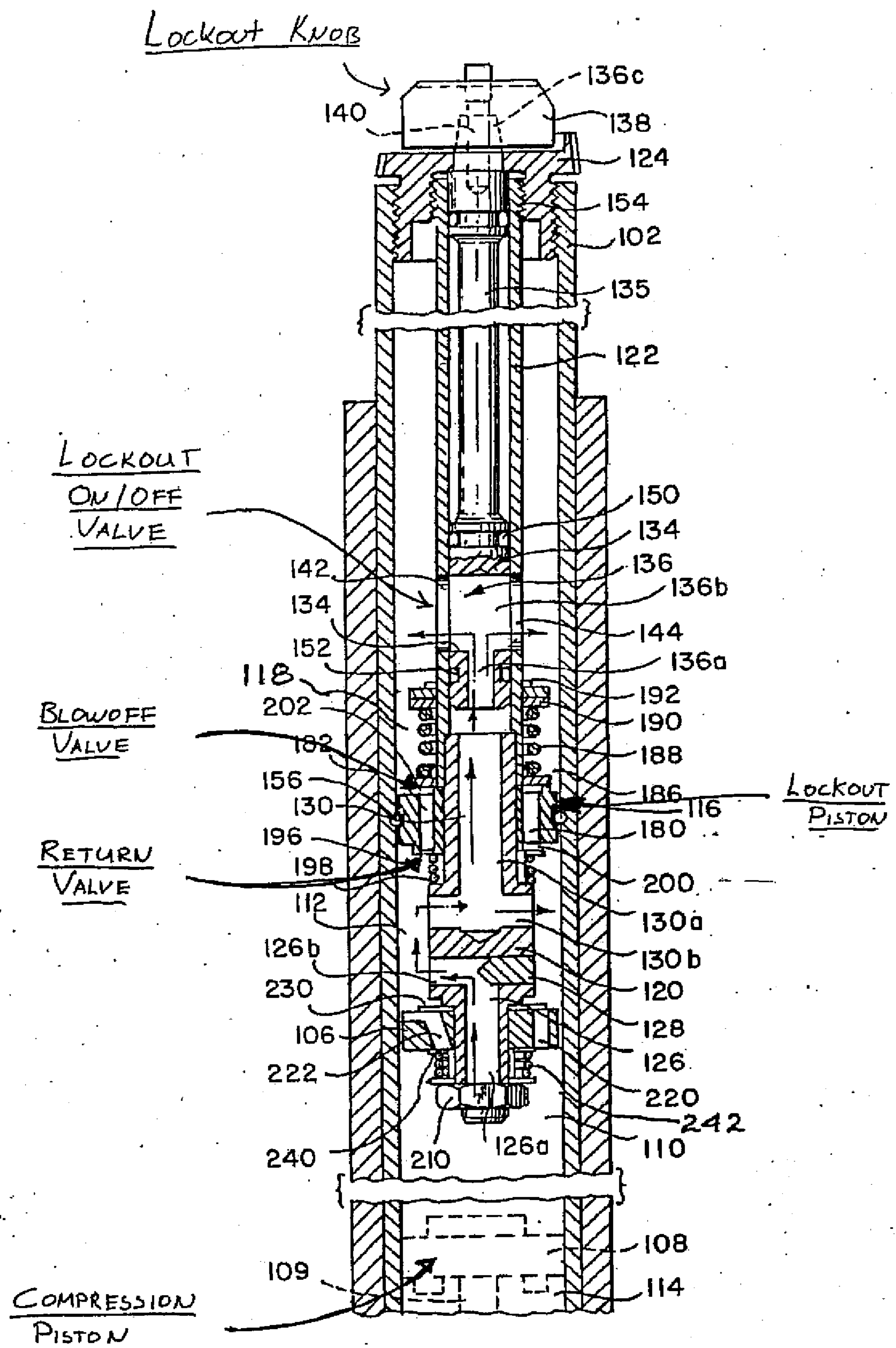
Lockout Knob
136c
140
138
124
154
102
135
122
Lockout
On/Off
Valve
150
134
142
136
136b
134
144
152
136a
118
202
192
190
Blowoff
Valve
182
188
156
186
Lockout
Piston
130
116
196
180
Return
Valve
198
200
112
130a
126b
130b
230
120
106
128
126
222
220
242
240
210
126a
110
108
109
114
Compression
Piston

Figure 3

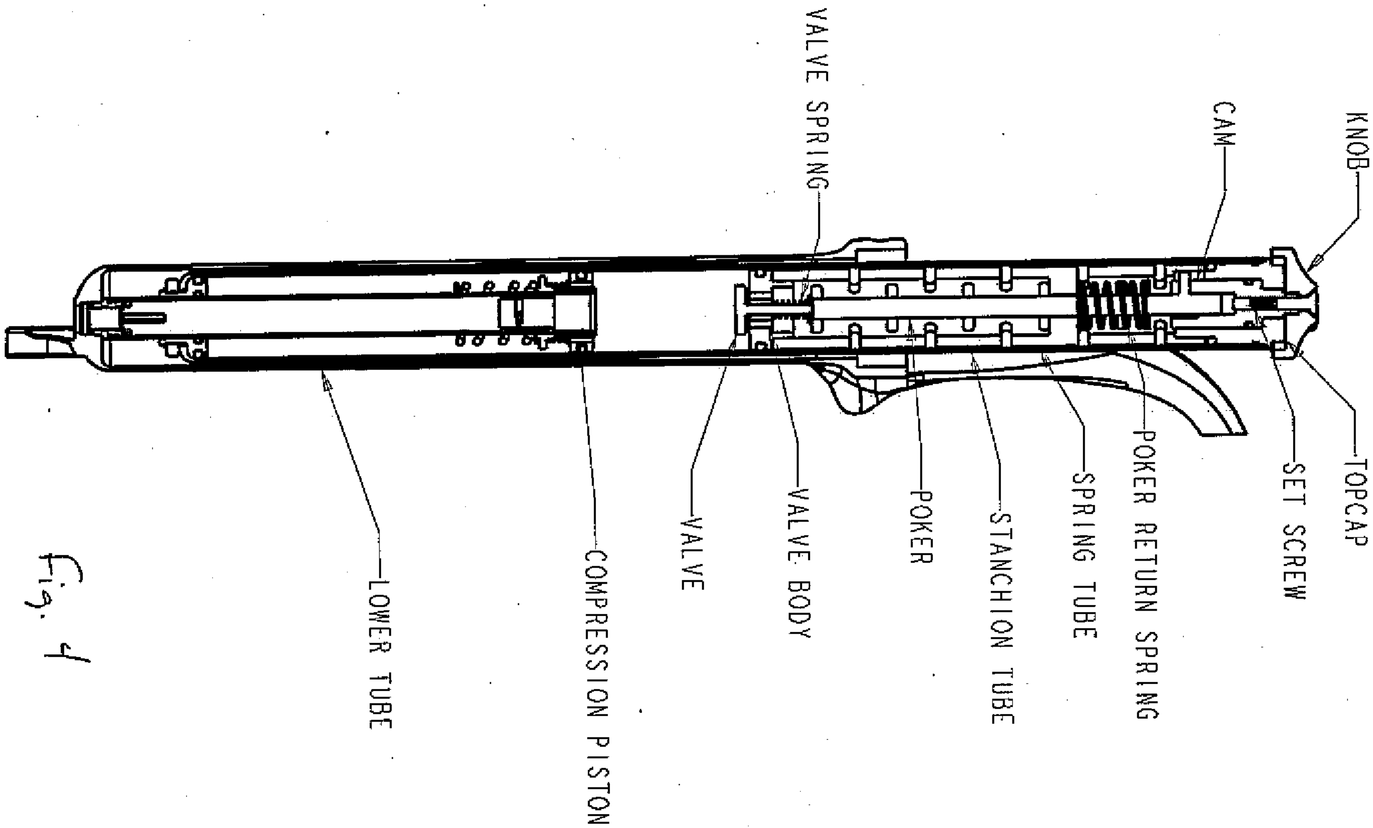

Fig. 4

Exhibit 14 of 20

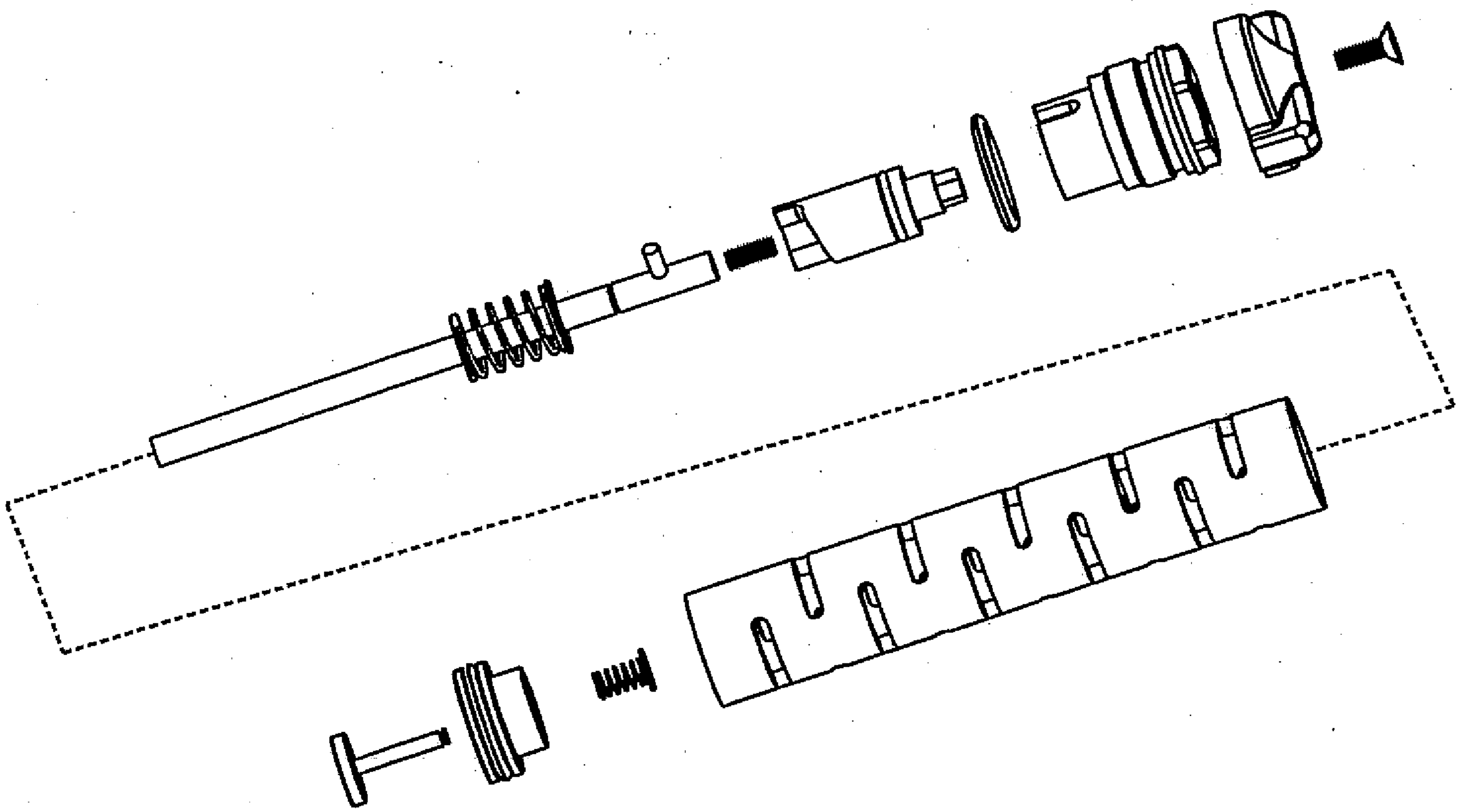

Fig 5

INSERT MODE

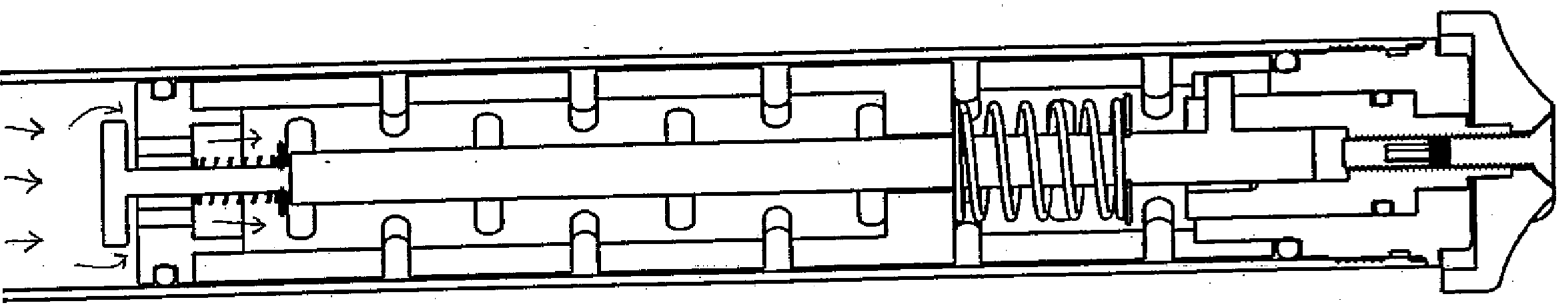

Figure 6

Exhibit 16 of 20

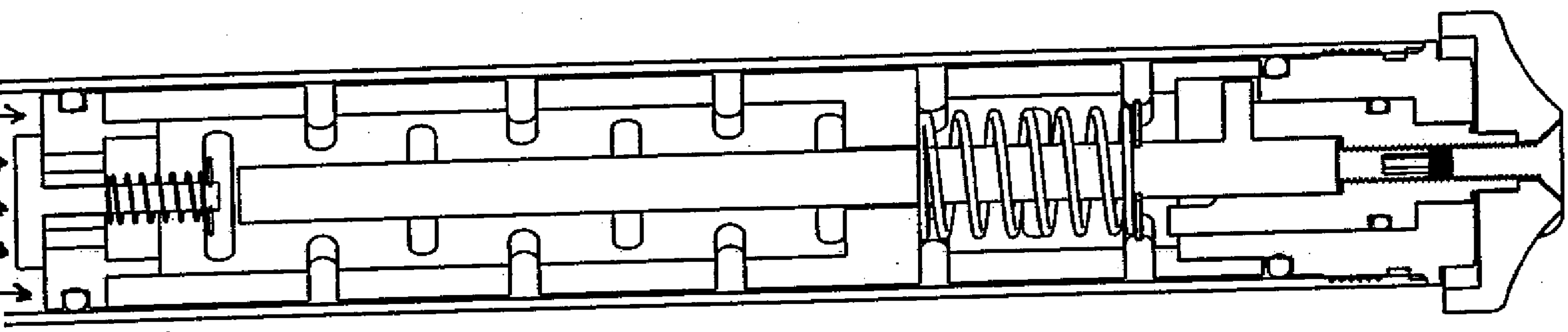

Figure 7

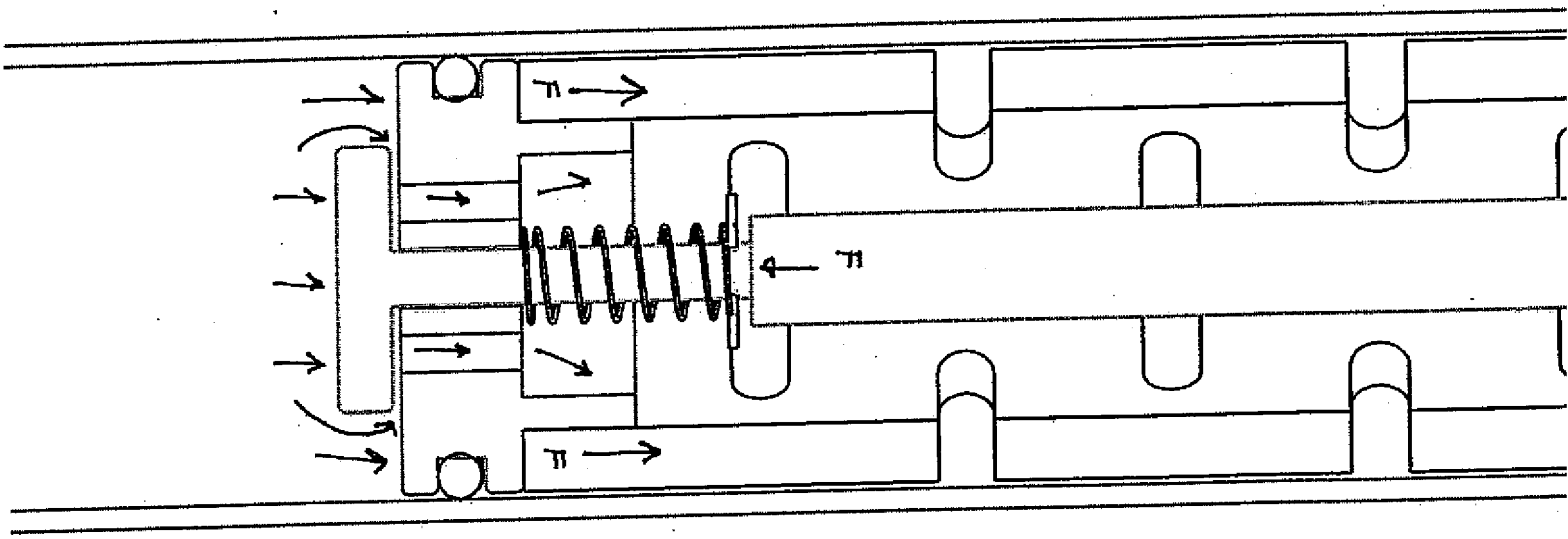

Figure 8

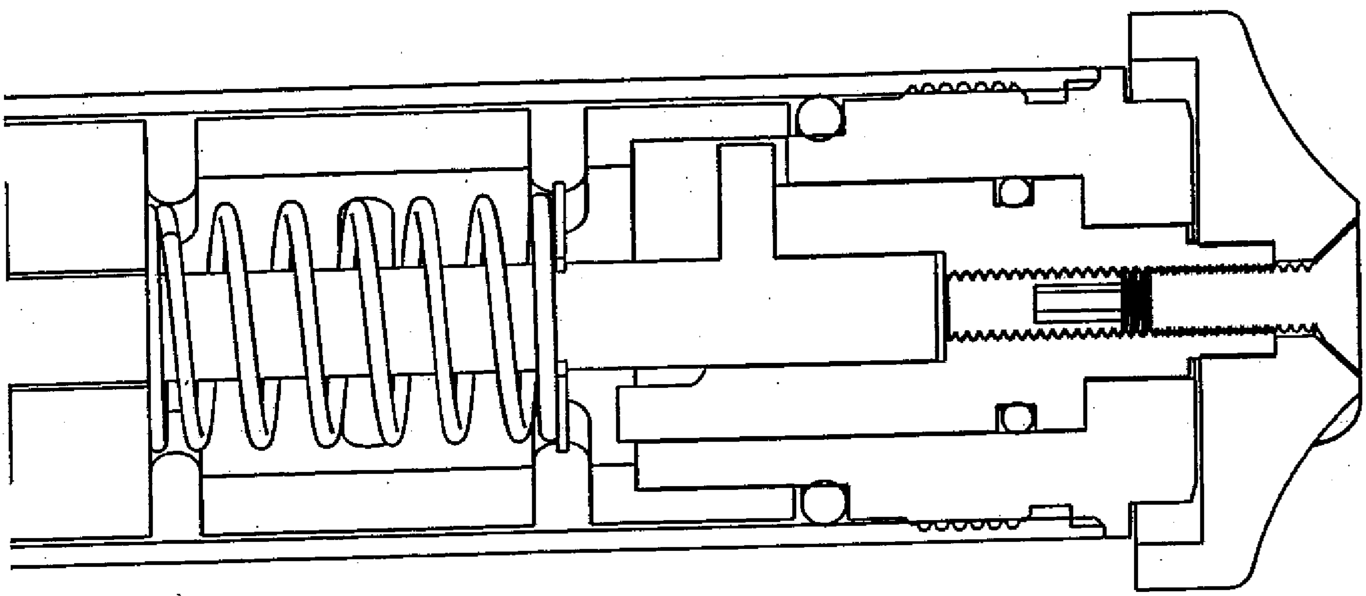

Figure 9

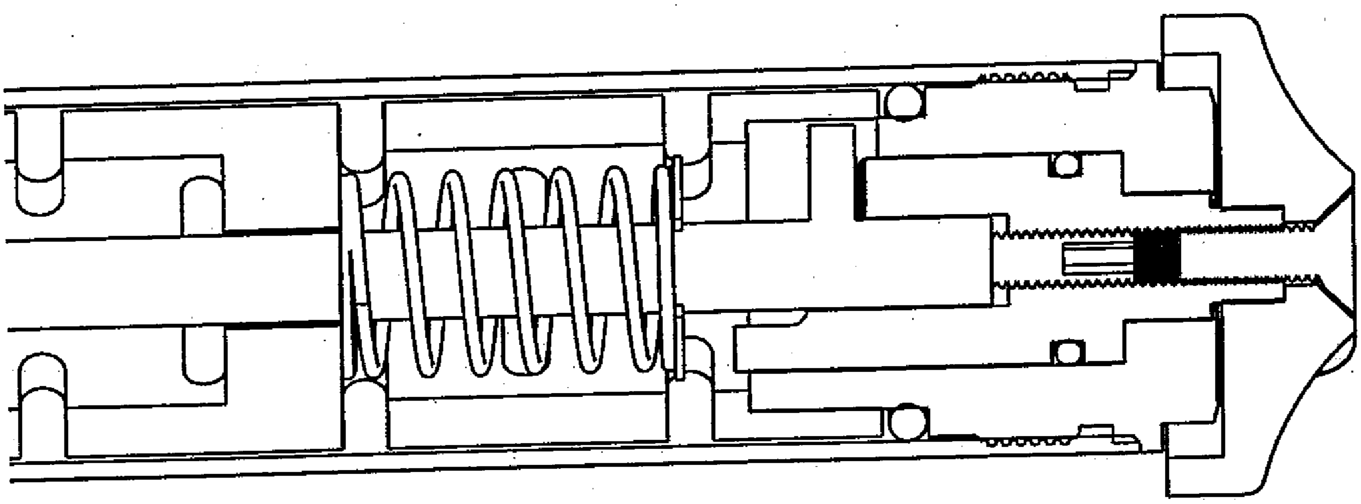

Figure 10